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Depletion manipulations decrease openness to dissent via increased anger

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Depletion manipulations decrease openness to dissent via increased anger

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We investigated a potential outcome of ego depletion manipulations and an important factor behind cooperative failure: a lack of openness to others' dissenting opinions. Across five studies in a variety of task settings, we examined the effect of depletion manipulations on openness to dissent and investigated two negative emotions as potential mediators of this process: fatigue and anger. The results demonstrated a negative effect of depletion manipulations on openness to dissent through increased anger rather than fatigue (Studies 1–5). In Studies 3 and 4, we also eliminated perceived trust towards a task counterpart as a significant mediator of the relationship between depletion manipulations and openness to dissent. These findings help clarify the nature of ego depletion manipulations and shed light on why individuals may fail to consider others' dissenting opinions and, thus, fall short of achieving cooperation.

In April 2018, approximately 20,000 Arizonan teachers went on strike in order to resist a proposal from the Arizona governor (Gonzales, 2018). This proposal indicated that the state government would give teachers an incremental pay raise but would not provide increased funding for schools to improve educational environments. Due to the strike, the absence of the instructors affected more than 800,000 students' education (Brownfield, 2018). To terminate this strike, the Arizona state government eventually conceded to increase school funding.

What might have led teachers to vote for a strike and reject the proposal from the governor? A contributing factor could be the teachers' long work hours and demanding job (Russakoff, 2018), which might have affected their openness to opposing views, potentially by depleting a reservoir of mental resources. Ego depletion or self-control depletion refers to the notion that the mental resources that influence our capacity to control our thoughts, feelings, or behaviours are finite and can often be used up (Baumeister & Vohs, 2007; Hagger, Wood, Stiff, & Chatzisarantis, 2010). Some studies indicate that depletion manipulations have various negative interpersonal outcomes, such as tendencies towards selfishness (Achtziger, Alós-Ferrer, & Wagner, 2015) and reduced prosocial behaviour (Xu, Bègue, & Bushman, 2012).

In the most recent 3 years, however, the ego depletion landscape has shifted dramatically, with many commentators questioning whether well-documented ego depletion effects are valid and replicable. Although initial meta-analytic reports indicated a significant, medium effect size of depletion manipulations (d = .62; Hagger *et al.*, 2010), recent research has presented empirical evidence against ego depletion having any

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significant impact. For instance, in a subsequent meta-analytic report that included unpublished studies (Carter, Kofler, Forster, & McCullough, 2015) and in a large-scale replication with registered studies using short depletion manipulations (Hagger *et al.*, 2016), ego depletion effects were found to be non-significant. The non-significant findings suggest that overestimated effects of ego depletion may be due to questionable research practices, such as performing analyses during data collection and stopping data collection upon the emergence of desired results (Friese, Loschelder, Gieseler, Frankenbach, & Inzlicht, 2018).

To avoid such practices, recently published studies of ego depletion have often been pre-registered (e.g., Alquist *et al.*, 2018; Garrison, Finley, & Schmeichel, 2018) or highly transparent (e.g., Francis, Milyavskaya, Lin, & Inzlicht, 2018). To address the weaknesses of traditional depletion manipulations with a short duration or weak intensity (e.g., Letter 'e' task; Baumeister, Bratslavsky, Muraven, & Tice, 1998), recent research has also used different manipulation tasks (e.g., Blain, Hollard, & Pessiglione, 2016; Sjåstad & Baumeister, 2018). In keeping with these developments, we followed the current trend of ego depletion research by including the results of a pre-registered study and using depletion manipulations differing from the original depletion task.

In the current paper, we investigate the extent to which depletion manipulations impair a potential predictor of cooperative failure (Tjosvold & Sun, 2003): openness to dissent – defined as an engagement of dissenting ideas from another individual in an open-minded way (Tröster & van Knippenberg, 2012). Openness to dissent is associated with various beneficial outcomes, such as communication satisfaction (Vanlear, 1991), positive attitudes towards the adoption of new technology (Al-Gahtani & Shih, 2009), and the quality of interpersonal relationships within organizations (Anant, 2015). A lack of openness to dissent is also associated with a wide range of detrimental outcomes, such as aggressive behaviour (Sharma & Raju, 2013) and destructive reactions to conflict in culturally diverse workgroups (Ayoko, 2007). In particular, we empirically examine two possible routes through which depletion manipulations may impact openness to dissent, as suggested by distinct lines of research: fatigue and anger. Our original motivation was to examine the precursors of openness to dissent, but in the process of investigating this phenomenon, we ended up learning about the nuances of depletion manipulations. For instance, we learned that this line of research requires a clarification of how depletion manipulations influence their corresponding outcomes. Thus, we also discuss how our research findings can be useful in this regard.

Depletion manipulations may impair openness to dissent

Performing depletion tasks might negatively influence openness to dissent. In particular, individuals may ignore information that contradicts their preferences if they lack the mental energy required to scrutinize counterarguments (Fischer, Greitemeyer, & Frey, 2008). Although, to our knowledge, research has not directly examined the relationship between depletion manipulations and openness to dissent, studies across different domains suggest the existence of a negative association. For instance, research has indicated that individuals subject to depletion manipulations favour information consistent with their own preferences during decision-making processes (Fischer *et al.*, 2008). After taking perspectives from others, individuals who performed depletion tasks were also found to be less likely to comply with the others' viewpoints than individuals who were not subject to depletion tasks (Fennis, 2011). People subject to depletion manipulations also display less concern for others' interests – they engage in more

impulsive cheating (Gino, Schweitzer, Mead, & Ariely, 2011) and allocate more resources for themselves than another player in economic games (Achtziger *et al.*, 2015). Taken together, such findings suggest that individuals subject to depletion tasks may be more self-focused and less open to others' dissenting opinions.

The case for and against mediation via fatigue

How and why might performing depletion tasks impair openness to dissent? One clue comes from the way that performing a depletion task has been associated with fatigue. In particular, the strength model of self-control has likened the depletion process to tiring a muscle (Baumeister & Heatherton, 1996; Baumeister, Vohs, & Tice, 2007) – just as individuals experience fatigue after strenuous physical activities or a high amount of energy expenditure, so do they (according to this model) become depleted after heavy use of mental resources. Many studies have demonstrated that people who perform depletion tasks experience fatigue as measured not only by self-reported scales (e.g., Xu *et al.*, 2012) but also by physiological indicators, such as diminished heart rate variability (Segerstrom & Nes, 2007) and weak neural monitoring responses (Inzlicht & Gutsell, 2007).

Fatigue may in turn reduce openness to dissent because being open to others' perspectives can be an effortful process requiring significant resources, and research suggests that individuals who experience fatigue perceive their resources as limited (Lapointe, Vandenberghe, & Panaccio, 2011). In such situations, individuals may focus on obtaining more resources for themselves in order to rebuild energy (Cropanzano, Rupp, & Byrne, 2003) and may be less open to others' dissent. Consistent with this proposition, research has found that employees who have higher levels of fatigue are less likely to perform extra-role behaviours that benefit their organization or supervisor (Cropanzano *et al.*, 2003). In addition, daily exhaustion has been negatively associated with helping behaviours that are not specified in a role requirement (Trougakos, Beal, Cheng, Hideg, & Zweig, 2015). The researchers proposed that this negative association is due to a perception of limited resources.

On the other hand, researchers have proposed that fatigue increases vulnerability to social influence (Burkley, Anderson, & Curtis, 2011). Indeed, individuals with chronic fatigue syndrome tend to accept and act on others' suggestions (DiClementi, Schmaling, & Jones, 2001) and those with regulatory fatigue are inclined to agree with a persuasive message (Burkley, 2008). Furthermore, individuals with a high level of fatigue seek acceptance in personal relationships (Halbesleben, 2006), which may lead to a greater propensity for openness to dissent from the other individual. Consequently, fatigue could be positively associated with openness to dissent. Overall, much of this research is consistent with the strength model of self-control (whereby depletion manipulations expend energy, generating fatigue). However, it is unclear how fatigue influences openness to dissent.

The case for mediation via anger

Depletion manipulations may lead to lower openness to dissent through anger. Research has found that individuals subject to depletion manipulations are more likely to express irritation than those not subject to depletion manipulations when responding to controlling persuasive messages that include terms such as 'should' and 'need to' (Gal & Liu, 2011). Although individuals subject to depletion manipulations in that study may have become angry in response to provocation, these individuals may feel angry and act

accordingly even without being provoked. For instance, individuals may possess a certain level of angry feelings that are normally inhibited by their self-control strength and these inhibitory processes may be attenuated after an exertion of self-control (Gal & Liu, 2011).

Furthermore, the process model of self-control predicts that individuals subject to depletion manipulations are motivated to switch from an exertion of self-control to a pursuit of impulsive drives because self-control exertion depletes the resources that are used to restrain impulsive drives (Inzlicht & Schmeichel, 2012). Given the impulsive nature of anger (Barsade & Gibson, 2007), individuals with self-control depletion may experience greater feelings of anger and behave accordingly. For instance, depleted managers tend to supervise in a hostile manner in the normal course of work (Barnes, Lucianetti, Bhave, & Christian, 2015). Research also supports the link between depletion manipulations and anger-related behaviour by demonstrating that depletion manipulations lead to an increased preference for anger-themed content, angry faces, and anger-framed appeals (Gal & Liu, 2011).

In addition, threat-rigidity theory suggests that angry individuals focus on their personal goals and defend their position against potential threats to these goals (Staw, Sandelands, & Dutton, 1981). Angry individuals prefer their own perspectives over those of others (Bukowski & Samson, 2016). Relatedly, angry people have also been found to reject others' offers (Pillutla & Murnighan, 1996), have inferior interpersonal rapport with others (Allred, Mallozzi, Matsui, & Raia, 1997), and have a high likelihood of driving violence (Smith, Waterman, & Ward, 2006). These findings suggest that anger may prevent people from being open to others' different opinions. Taken together, the process model of self-control (i.e., motivation switches from an exertion of self-control to a pursuit of impulsive drives) predicts that depleted self-control will increase anger, which will in turn decrease openness to dissent.

The current research

To summarize, the literature on depletion manipulations and information processing suggests that performing depletion tasks may be negatively linked to openness to dissent. This causal relationship, however, has not been directly tested. Moreover, it is not clear how performing depletion tasks would influence openness to dissent. To address these issues, we tested predictions from two different models of self-control: The strength model of self-control highlights fatigue as a mediator of the relationships between depletion manipulations and their outcomes, whereas the process model of self-control implicates anger as a primary mediator. By examining these two perspectives, we sought to clarify the relative importance of energy depletion in the strength model and motivation switching in the process model. Relatedly, research on discrete emotions has also proposed that fatigue and anger are negative emotions associated with a lack of energy and a high level of energy, respectively (Barsade & Gibson, 2007). Thus, by examining anger and fatigue as potential consequences of performing depletion tasks, we sought to understand whether individuals subject to depletion manipulations feel tired or energetic. Our studies are the first to provide such an investigation. Finally and more broadly, by utilizing a wide variety of tasks, we aimed to uncover a potentially major pathway through which cooperative failure can occur.

To achieve greater generalizability, we used different tasks and measures of openness: openness to dissenting ideas (Study 1), a choice to read an explanation of an opposing position (Study 2), concession making (Study 3), a choice to read an explanation of a dissenting idea (Study 4), and a point allocation task to indicate a

preference for a choice to read an explanation of an opposing position or read evidence against an opposing position (Study 5). To motivate participants to engage seriously in the negotiation task for Study 3, individual negotiation outcomes in this study were also associated with actual monetary consequences based on existing research (Beersma & De Dreu, 1999). In addition, we examined perceived trust towards a task counterpart as an additional mediator of the relationships between depletion manipulations and openness to dissent in Studies 3 and 4.

We determined our sample size based on our available resources with an aim to use a large sample size (at least $N = 70$ in each condition). Our minimum sample size requirement (i.e., at least $N = 140$ [2 conditions: 70×2]) is also higher than the minimum sample size requirement ($N = 100$) and the average sample size ($N = 131.61$) of the registered studies in the most recent published replication report (Hagger *et al.*, 2016). For our online studies, we pre-determined our sample size and stopped collecting the data within one batch of data collection. For each laboratory study, we aimed to collect at least 70 participants in each condition and stopped our data collection within one semester. We conducted data analyses only after the completion of data collection in each study. We also confirm that there are no unreported experiments we conducted to examine the effects of depletion manipulations on openness to dissent via fatigue and anger.

STUDIES 1 AND 2: BUSINESS IDEA SELECTION AND HIRING TASKS

We started by examining how depletion manipulations are related to openness to dissent via fatigue and anger in Studies 1 and 2. To increase the generalizability of our findings, different research settings (i.e., a laboratory vs. online study), collaborative tasks, depletion manipulations, and measures of openness to dissent were employed in the two studies.

Participants and design

Study 1 included 142 undergraduate students (72.54% female; age: $M = 21.00$, $SD = 2.40$) who participated in a laboratory study in exchange for course credit. In Study 2, 200 adults recruited from Amazon's Mechanical Turk (MTurk) website participated in an online study in exchange for monetary compensation. In Study 2, two participants did not follow the instructions to submit valid responses and thus were excluded from our data set. The final sample for Study 2 consisted of 198 participants (99.00% valid responses, 48.99% female; age: $M = 35.45$, $SD = 10.99$). Participants in both studies engaged in a depletion or non-depletion task (randomly assigned; depletion: $N = 70$ and 92; non-depletion: $N = 72$ and 106 in Studies 1 and 2, respectively) before reporting fatigue and anger. Study 2 also consisted of 18 dropouts in the depletion condition (dropout rate[1] = 16.36%, [18/110]) and three dropouts in the non-depletion condition (dropout rate = 2.75%, [3/109]). Furthermore, the ratio of the number of dropouts to the number of valid completers (19.57%, [18/92]) in the depletion condition was higher than that in the non-depletion condition (2.83%, [3/106]; $\chi^2 = 11.70$, $df = 1$, $p < .001$).

[1] *A dropout rate is defined as the number of dropouts divided by the number of dropouts and valid completers based on Bosnjak and Tuten's (2001) definition.*

Procedures and measures

In Study 1, participants came to a large room and used a computer to read the instructions and answer questions in their own cubicles. They read that they would be paired with a partner with whom they would discuss solutions for replacing a failing university food court (modified from Goncalo & Duguid, 2012). Participants and their partner posed as representatives in a management consulting firm and would help the school administration evaluate and select the most creative and appropriate business idea. In Study 2, participants used their own electronic device to access an online survey. Participants posed as hiring officers of a large company and needed to decide whether the contract of a manager, Mr. Wilson, should be extended (modified from Frey, 1986). Mr. Wilson had been hired on a one-year contract to manage a fashion store one year ago. To associate this decision-making task with different viewpoints, participants also read that Mr. Wilson's tenure involved a mixture of successes and failures.

All participants from each study correctly answered a task comprehension check question regarding the study's task. Then, participants in Study 1 selected the most creative idea from a list of four ideas and explained their selection, whereas those in Study 2 made a decision on whether or not to extend Mr. Wilson's contract and provided their reasons to support the decision. One participant in Study 2 typed only a single word 'strife', which might reflect the participant's angry disagreement over an issue, but could not constitute a clear reason for his or her hiring decision and therefore was excluded from our data set. To make the communication tasks more believable, participants from both studies provided their initials, which were used in ostensible communications with other participants (see below).

Next, participants engaged in one of two versions of a typing task adopted and modified from previous studies (e.g., Muraven, Shmueli, & Burkley, 2006, Experiment 2). In the task for Study 1, participants were shown a word and then requested to type the word while skipping the vowel(s) that appeared directly after two consonants. To ensure comprehension of the rule, we had participants perform two practice trials, revealing the correct answers. Then, participants performed the task for 2 words (non-depletion condition) or 55 words (depletion condition). In both conditions, participants were told to type as quickly and accurately as possible and given a timer displaying the number of seconds spent on each word. Participants in Study 2 engaged in one of two versions of a typing task modified from Study 1. The typing rule involved skipping the vowel(s) that appeared directly after one consonant. Participants in the non-depletion condition performed the task for 2 words, whereas those in the depletion condition performed the task for 25 words. One participant in Study 2 did not follow the instructions and provided wrong answers for all the questions and therefore was excluded from our data set.

Participants then answered a manipulation check item (adapted from Baumeister, 1999), similar to those used in other studies (e.g., Baumeister *et al.*, 1998; Dvorak & Simons, 2009; Finkel & Campbell, 2001): 'To what extent did you have to concentrate on the task?' (1 = *very little*, 7 = *very much*; Study 1: $M = 5.65$, $SD = 1.07$; Study 2: $M = 5.49$, $SD = 1.66$). Then, participants reported their feelings (1 = *not at all*, 7 = *extremely*) of fatigue (Study 1: $\alpha = .89$, $M = 3.12$, $SD = 1.62$; Study 2: $\alpha = .93$, $M = 2.41$, $SD = 1.43$) on a 3-item scale (i.e., 'I feel tired/sluggish/drowsy') and anger (Study 1: $\alpha = .91$, $M = 2.29$, $SD = 1.55$; Study 2: $\alpha = .92$, $M = 2.03$, $SD = 1.47$) on a 3-item scale (i.e., 'I feel angry/hostile/irritated').

Afterwards, participants were informed that they were paired with another participant (known by the initials 'VL' in Study 1 and 'SW' in Study 2) and that based on a random draw, their partner would send them a message first regarding their proposed business

idea and hiring decision in Studies 1 and 2, respectively. To lend further realism to the interactions and make the situation associated with different viewpoints, the message included the participant's initials and the opinion difference between participants and their partner (Study 1: 'Hi [Participant's Initials]. We have different preferences. I feel that my selection is better than yours.'; Study 2: 'Hi [Participant's Initials]. We selected different decisions. I think that Mr. Wilson's contract should/[should not] be extended'.). Then, participants in Study 1 received two dissenting ideas, including a store renting office wear and a movie theatre at discounted rates, from their partner.

To measure openness to dissent in Study 1, participants rated three statements regarding their openness to each of the two ideas (1 = *strongly disagree*; 7 = *strongly agree*). The three statements were adapted from Tröster and van Knippenberg's (2012) 3-item openness scale. The statements included: I am seriously considering VL's idea, 'A store renting office wear'/'A movie theatre at discounted rates', I am open to VL's idea, 'A store renting office wear'/'A movie theatre at discounted rates', and I will give VL's idea, 'A store renting office wear'/'A movie theatre at discounted rates', a fair evaluation. The average of these ratings achieved an acceptable inter-item reliability (α = .73; M = 5.27, SD = 0.92); thus, average values were used to measure openness to dissenting ideas. To decrease the possibility of social desirability bias in the self-rated openness measure, we used a forced-choice task in Study 2 to assess openness because this task reflected participants' behaviour and was less likely to be influenced by social desirability bias than self-reported ratings (Nederhof, 1985). Specifically, the task involved choosing whether to read SW's explanation (coding = 1) or not to read the explanation (coding = 0). Thus, higher scores reflected higher openness to dissent on this task (M = 0.89, SD = 0.32). This choice constitutes an appropriate openness measure as research has suggested that openness involves listening to different ideas from a counterpart (Slavec, Drnovšek, & Hisrich, 2017; Tröster & van Knippenberg, 2012), and listening to another individual's different ideas has also been used as a measure of openness (e.g., Righetti, Kumashiro, & Campbell, 2014). Participants also reported their demographics. Finally, they were debriefed.

Results and discussion

Distinction between fatigue and anger

We first ran comparative confirmatory factor analyses (CFAs) to examine the uniqueness of the 'fatigue' and 'anger' scales. We constrained each item to load on the factor representing its construct and to avoid cross-loadings. We used Chen's (2005) strategy to evaluate the CFA results. To meet an acceptable standard of each CFA model, the value of comparative fit index (CFI) should be higher than 0.90 and the value of standardized root mean square residual (SRMR) should be lower than 0.10 (Kline, 2011).

Fit statistics met acceptable criteria for the unconstrained two-factor model (Study 1: χ^2 = 13.08, df = 8, p = .109, CFI = 0.99, SRMR = 0.04; Study 2: χ^2 = 17.51, df = 8, p = .025, CFI = 0.99, SRMR = 0.03), but not the one-factor model with the covariance between fatigue and anger set equal to one (Study 1: χ^2 = 199.07, df = 9, p < .001, CFI = 0.69, SRMR = 0.18; Study 2: χ^2 = 352.38, df = 9, p < .001, CFI = 0.67, SRMR = 0.17) A chi-squared difference test confirmed that the two-factor model was significantly better than the one-factor model (Studies 1 and 2: χ^2 = 185.99 and 334.87, respectively; both dfs = 1, both ps < .001). Fatigue and anger were significantly and positively correlated (Studies 1 and 2: r = .50 and .56, both ps < .001).

Manipulation check

Ordinary least squares (OLS) regression analyses were conducted to examine the effectiveness of the depletion manipulations. The results demonstrated that individuals in the depletion condition (Study 1: $M = 5.83$, $SD = 0.95$; Study 2: $M = 6.07$, $SD = 1.18$) reported that they needed to concentrate on the typing task more than did those in the non-depletion condition (Study 1: $M = 5.47$, $SD = 1.16$; $B = 0.36$, $SE = .18$, $p = .048$, 95% CI = [0.004, 0.709], $R^2 = .03$; Study 2: $M = 5.00$, $SD = 1.85$; $B = 1.07$, $SE = .22$, $p < .001$, 95% CI = [0.62, 1.51], $R^2 = .10$), which confirmed the effectiveness of our manipulation.

Depletion manipulations and openness to dissent

Given that our dependent variable was assessed using continuous and bi-categorical variables that represented different levels of openness in Studies 1 and 2, respectively, the associations between depletion manipulations and openness to dissent were examined using a robust regression model (i.e., an OLS regression model with a robust standard error, Stock & Watson, 2012). The results indicated marginal, negative effects of the depletion manipulations on openness to dissent (Study 1: $B = -0.30$, $SE = .15$, $p = .055$, 95% CI = [−0.60, 0.01], $R^2 = .03$; Study 2: $B = -0.08$, $SE = .05$, $p = .094$, 95% CI = [−0.17, 0.01], $R^2 = .01$. Specifically, participants in the depletion condition (Study 1: $M = 5.11$, $SD = 0.97$; Study 2: $M = 0.85$, $SD = 0.36$) had marginally lower openness to dissent than did those in the non-depletion condition (Study 1: $M = 5.41$, $SD = 0.86$; Study 2: $M = 0.92$, $SD = 0.27$). These results did not achieve a conventional significance with a p-value less than .05 and the marginally significant impact of the depletion manipulation on openness to dissent may be due to a suppressing effect of a different mediator (Rucker, Preacher, Tormala, & Petty, 2011). For instance, the depletion manipulation may increase openness by eliciting fatigue because fatigue also positively predicts openness as in our previous discussion. Rucker *et al.* (2011) also concluded that a non-significant association between an independent variable and a dependent variable should not preclude researchers from performing a theory-driven test of an indirect effect because an indirect effect depends on the strengths of the associations between an independent variable and a mediator and between a mediator and a dependent variable. Thus, the only marginally significant, negative effects of the depletion manipulations on openness to dissent do not invalidate our subsequent tests of indirect effects.

Indirect effects via fatigue and anger

We used the SPSS PROCESS program (Hayes, 2013) as it takes into account both categorical and continuous outcome variables using logistic and linear regression models, respectively. First, depletion manipulations increased both fatigue (Study 1: $B = 1.35$, $SE = .25$, $p < .001$, 95% CI = [0.85, 1.84], $R^2 = .17$; Study 2: $B = 0.40$, $SE = .20$, $p = .049$, 95% CI = [0.002, 0.798], $R^2 = .02$) and anger (Study 1: $B = 1.15$, $SE = .24$, $p < .001$, 95% CI = [0.68, 1.63], $R^2 = .14$; Study 2: $B = 0.54$, $SE = .21$, $p = .009$, 95% CI = [0.14, 0.95], $R^2 = .03$). Specifically, participants in the depletion condition had significantly higher fatigue and anger than did those in the non-depletion condition. Table 1 presents descriptive statistics of fatigue and anger in each condition across the five studies. In addition, controlling for the effects of the depletion manipulations, fatigue was not significantly associated with openness to dissent (Study 1: $B = 0.07$, $SE = .06$, $p = .244$, 95% CI = [−0.05, 0.18], $\Delta R^2 = .01$; Study 2: $B = 0.39$, $SE = .23$, $p = .088$, 95%

Table 1. Descriptive statistics of fatigue and anger in each condition

Condition	Depletion		Non-depletion		Depletion		Non-depletion	
Study	Fatigue: Mean	Fatigue: *SD*	Fatigue: Mean	Fatigue: *SD*	Anger: Mean	Anger: *SD*	Anger: Mean	Anger: *SD*
1	3.80_a	1.55	2.46_b	1.42	2.88_a	1.76	1.72_b	1.04
2	2.62_a	1.48	2.22_b	1.36	2.32_a	1.62	1.78_b	1.28
3	3.21_a	1.86	2.41_b	1.52	2.60_a	1.75	1.88_b	1.22
4	4.48_a	1.65	3.44_b	1.57	3.71_a	1.70	2.44_b	1.54
5	2.91_a	1.82	2.68_a	1.61	3.56_a	1.98	2.58_b	1.70

Note. The different subscript letters (i.e., a and b) indicate significance ($p < .05$) between different mean values within each study.

CI = [−0.06, 0.83], pseudo ΔR^2 = .02), but anger was significantly negatively associated with openness to dissent (Study 1: B = −0.13, SE = .06, p = .033, 95% CI = [−0.24, −0.01], ΔR^2 = .03; Study 2: B = −0.66, SE = .18, p < .001, 95% CI = [−1.01, −0.32], pseudo ΔR^2 = .08).

The variance inflation factors (VIFs) of the independent and control variables were all less than 1.48 in these regression models, indicating low multicollinearity (VIF < 10, Hair, Black, Babin, & Anderson, 2010). The bootstrapping results with 5,000 repetitions demonstrated that the depletion manipulation reduced openness to dissent via increased anger (Study 1: 95% CI = [−0.31, −0.02]; Study 2: 95% CI = [−0.85, −0.06]) rather than via increased fatigue (Study 1: 95% CI = [−0.05, 0.26]; Study 2: 95% CI = [−0.01, 0.63]). Thus, the results consistently demonstrated that depletion manipulations indirectly decreased openness to dissent through increased anger rather than fatigue. Although research has indicated that a significant difference in dropout rates between the experimental and control condition could influence the study results (Zhou & Fishbach, 2016), the consistent results between our laboratory and online studies (i.e., Studies 1 and 2) can help to alleviate the concern of the conditional difference in the dropout rate.

STUDIES 3 AND 4: NEGOTIATION AND PROBLEM IDENTIFICATION TASKS

In Studies 3 and 4, we sought to replicate and extend the results in Studies 1 and 2. To expand task settings, Study 3 used a conflict resolution situation (Straus, 1999). Consistent with existing research, separate parties competed with each other over conflicting interests on a focal negotiation issue (Pruitt & Carnevale, 1993). We used concession making to measure openness to dissent (Cohen *et al.*, 2007) – this measure reflects unilateral consideration or acceptance of another party's offer, which can be regarded as openness to the other party's suggestions.

Whereas Studies 1–3 involved pre-assigned choices in a decision-making task, research on the anchoring and adjustment heuristic (Epley & Gilovich, 2001) suggests that individuals may be less open to a dissenting idea (i.e., may be reluctant to adjust their idea to a different idea) when they generate their own ideas rather than when they are exposed to pre-assigned choices. Thus, to provide a stronger test of openness to dissent involving situations where individuals have to make adjustments from self-generated stances, we used a collaborative idea generation task in Study 4 that allowed individuals to generate their own initial ideas.

A potential limitation of Studies 1 and 2 is that they only examined (negative) emotions as moderators of the negative relationship between depletion manipulations and openness to dissent. Thus, in Studies 3 and 4, we also examined an important perception process – perceived trust towards a task counterpart (Olekalns, Lau, & Smith, 2007) – as a potential mediator. Past research has suggested a negative relationship between depletion manipulations and perceived trust towards a task counterpart. For instance, ego depletion reportedly decreases trust towards another player in economic games (Ainsworth, Baumeister, Ariely, & Vohs, 2014). Relatedly, individuals subject to a depletion manipulation have been found to perceive a romantic partner's cheating behaviour as more severe than those not subject to a depletion manipulation (Stanton & Finkel, 2012). Performing a depletion task also increased negative stereotypical responses (i.e., associating Black male faces with harmful objects in a weapon identification task, Govorun & Payne, 2006).

In turn, perceived trust towards a task counterpart may be positively associated with openness to dissent. Trust may enhance an acceptance of information provided as sincere and accurate in negotiation contexts (De Dreu, Giebels, & Van de Vliert, 1998). Perceived trust towards a task counterpart is positively associated with concession-making behaviour with the counterpart (De Dreu, Beersma, Stroebe, & Euwema, 2006) and acceptance of the counterpart's message (Parks, Henager, & Scamahorn, 1996). An individual with a higher level of perceived trust towards others is also less likely to use persuasion tactics to advance his or her agenda at the expense of others' preferred outcomes (Gunia, Brett, Nandkeolyar, & Kamdar, 2011). These studies suggest that people with a higher level of perceived trust towards others are more likely to be receptive to others' dissenting opinions. Thus, we propose that a depletion manipulation may decrease openness to dissent via a decrease in perceived trust towards a task counterpart.

Participants and design

Two hundred adults completed an online MTurk study in exchange for monetary compensation in Study 3, whereas 159 university students completed a laboratory study in exchange for course credit in Study 4. One participant and two participants were excluded from the data sets of Studies 3 and 4, respectively, because they answered the task comprehension check item incorrectly. In Study 4, one participant did not follow the instructions to submit his/her full responses, and another participant reported that he/she had done a similar study before and his/her opinion was the same as the opinion of the online confederate in the task and thus the pre-programmed message involving a dissenting opinion became invalid to this participant. The final samples consisted of 199 participants (99.50% valid responses, 51.26% female; age: $M = 36.32$, $SD = 11.81$) in Study 3 and 155 participants (97.48% valid responses, 65.81% female; age: $M = 21.57$, $SD = 1.60$) in Study 4.

Studies 3 and 4 utilized the same research design (depletion: $N = 91$ and 72; non-depletion: $N = 108$ and 83, respectively) as in Studies 1 and 2. Study 3 also consisted of 18 dropouts in the depletion condition (dropout rate = 16.51%, [18/109]) and 3 dropouts in the non-depletion condition (dropout rate = 2.70%, [3/111]). Furthermore, the ratio of the number of dropouts to the number of valid completers (19.78%, [18/91]) in the depletion condition was higher than that in the non-depletion condition (2.78%, [3/108]; $\chi^2 = 12.15$, $df = 1$, $p < .001$).

Procedures and measures

The same procedures were used as in Studies 1 and 2 and participants engaged in a task with their counterpart via the Internet. Participants read a negotiation scenario modified from Dimotakis, Conlon, and Ilies (2012) in Study 3 and a collaboration task scenario modified from Tsai and Bendersky (Study 2, 2016) in Study 4. In Study 3, they served as representatives of Seascape Incorporated, which planned to merge with Oceanview Enterprises. Representatives from both companies were asked to negotiate a policy regarding signing bonuses for the merged company. Historically, Seascape offered generous signing bonuses, whereas Oceanview offered no bonuses. Participants in Study 4 served as Student Council representatives to help identify problems that adversely affect students' educational experiences and student life. They also read different statistics regarding the school in recent years, such as tuition rates and student admissions. Then, they indicated the most serious problem in the school. Participants in both studies provided their initials.

Subsequently, participants in Study 3 engaged in one of two versions of a typing task adapted from Study 1. They also received feedback on their performance in order to increase their attention to the study. The word 'Incorrect' briefly appeared on the centre of the screen after each time participants submitted an incorrect answer. This modification of the typing task was not only consistent with other depletion manipulations with performance feedback (e.g., Lange, Seer, Rapior, Rose, & Eggert, 2014; Shelton *et al.*, 2013), but also increased the generalization of our research findings. Participants in Study 4 engaged in one of two versions of a typing task slightly modified from Study 2 with different word stimuli. After doing three practice trials, participants performed the task for 2 words (non-depletion condition) or 60 words (depletion condition).

After completing the tasks, participants answered the same manipulation check item (Study 3: $M = 5.87$, $SD = 1.39$; Study 4: $M = 5.91$, $SD = 1.81$) and completed the same fatigue (Study 3: $\alpha = .93$, $M = 2.77$, $SD = 1.73$; Study 4: $\alpha = .90$, $M = 3.03$, $SD = 1.73$) and anger (Study 3: $\alpha = .90$, $M = 2.21$, $SD = 1.52$; Study 4: $\alpha = .91$, $M = 3.92$, $SD = 1.68$) scales as in Studies 1 and 2. Next, participants in Study 4 received a message with the participant's initials and the opinion difference between participants and their partner: 'Hi [Participant's Initials], We have different preferences. I feel that the most serious problem is that students are becoming less satisfied with the instructors' teaching quality. I feel that my idea is better than yours'. To measure perceived trust towards their counterpart in Studies 3 and 4, participants also completed a 4-item trust scale (Study 3: $\alpha = .77$, $M = 3.84$, $SD = 1.21$; Study 4: $\alpha = .87$, $M = 4.14$, $SD = 1.09$; 1 = strongly disagree, 7 = strongly agree) adapted from Olekalns *et al.* (2007). The statements included: '[Subject]'s behaviour will meet my expectations', '[Subject] will try to be someone who keeps promises and commitments', '[Subject] will know that the benefits of maintaining trust are higher than the costs of destroying it', and '[Subject] will do what he/she says he/she will do'. The subject of the statements in Study 3 was 'My counterpart,' whereas the subject of the statements was SC (i.e., the initials of the online counterpart) in Study 4.

Subsequently, participants in Study 3 were requested to negotiate with their Oceanview counterpart to have the merged company institute signing bonuses at a generous level (i.e., 12% of starting salaries). Consistent with previous research (e.g., Beersma & De Dreu, 1999), participants were also given incentives to maximize their personal performance and to achieve an agreement. Specifically, participants read that they would receive an additional 50% monetary reward (only) if they achieved a final agreement that was one of the three highest levels of signing bonuses among all participants. However, if no consensus was achieved, this negotiation would be considered a failure and participants would forfeit any additional monetary reward. The negotiation range of signing bonuses was between 0% and 12% of starting salaries. After submitting their first offer, participants read that their counterpart had rejected their offer and had recommended 0% of the starting salary for the signing bonus. To lend further realism to the interactions, they then read an alleged message from their counterpart acknowledging the differences between their proposals and were asked to reply to their counterpart's message.

Afterwards, participants in Study 3 submitted their second offer. The counterpart's responses were pre-programmed to reject the second offer if the signing bonus offer was higher than 6.53% of the starting salary and to accept the second offer if the signing bonus offer was lower than or equal to this amount. Then, the participants were informed that the negotiation was over. A score of unilateral concession making was computed using the

signing bonus of the first offer deducted by the signing bonus of the second offer based on prior research (Adam, Shirako, & Maddux, 2010). A higher score indicated greater concession making (Units: % of the starting salary; M = 2.16, SD = 1.88). To measure openness to dissent in Study 4, participants received a message from their counterpart, SC, and then were given a choice to read an explanation of the dissenting idea (coding = 1, choice to read SC's explanation; coding = 0, choice not to read SC's explanation). Therefore, higher scores reflected higher openness to dissent on the task of Study 4 (M = 0.95, SD = 0.21). Participants in both studies also reported their demographics. Finally, they read a debriefing paragraph.

Results and discussion

Distinction between fatigue and anger

Comparative CFAs confirmed the distinctiveness of the fatigue and anger constructs. Fit statistics met acceptable criteria for the two-factor model (Study 3: χ^2 = 4.19, df = 8, p = .839, CFI = 1.00, SRMR = 0.02; Study 4: χ^2 = 27.39, df = 8, p = .001, CFI = 0.97, SRMR = 0.04), but not the one-factor model (Study 3: χ^2 = 318.12, df = 9, p < .001, CFI = 0.65, SRMR = 0.21; Study 4: χ^2 = 225.26, df = 9, p < .001, CFI = 0.70, SRMR = 0.15). A chi-squared difference test confirmed that the two-factor model was significantly better than the one-factor model (Studies 3 and 4: χ^2 = 313.93 and 197.87, respectively; both dfs = 1, both ps < .001). Fatigue and anger were significantly and positively correlated (Studies 3 and 4: r = .41 and .57, both ps < .001).

Manipulation check

The OLS regression results demonstrated that individuals in the depletion condition (Study 3: M = 6.44, SD = 0.86; Study 4: M = 6.24, SD = 0.97) reported that they needed to concentrate on the typing task more than did those in the non-depletion condition (Study 3: M = 5.40, SD = 1.57; B = 1.04, SE = .18, p < .001, 95% CI = [0.68, 1.40], R^2 = .14; Study 4: M = 5.63, SD = 1.28; B = 0.61, SE = .18, p = .001, 95% CI = [0.25, 0.97], R^2 = .07), which confirmed the effectiveness of our depletion manipulation.

Depletion manipulations and openness to dissent

The same analyses (i.e., robust regression analyses) in Studies 1 and 2 were used to examine the effects of depletion manipulations on openness to dissent. The results showed a significant, negative effect of the depletion manipulations on openness to dissent (Study 3: B = −0.58, SE = .27, p = .030, 95% CI = [−1.11, −0.06], R^2 = .02; Study 4: B = −0.10, SE = .04, p = .006, 95% CI = [−0.17, −0.03], R^2 = .05). Participants in the depletion condition (Study 3: M = 1.85, SD = 1.94; Study 4: M = 0.90, SD = 0.30) had significantly lower openness than did those in the non-depletion condition (Study 3: M = 2.43, SD = 1.78; Study 4: M = 1.00, SD = 0.00).

Indirect effect via perceived trust

Hayes' (2013) indirect effect procedure was used to assess the indirect effect of depletion manipulations on openness via perceived trust. First, the depletion manipulations did not significantly affect perceived trust (Study 3: B = 0.13, SE = .17, p = .440, 95%

CI = [−0.21, 0.47], R^2 = .003; Study 4: B = 0.14, SE = .18, p = .418, 95% CI = [−0.20, 0.49], R^2 = .004). Second, controlling for the effect of the depletion manipulations, perceived trust was not consistently associated with openness (Study 3: B = 0.36, SE = .11, p < .001, 95% CI = [0.15, 0.57], ΔR^2 = .05; Study 4: B = 0.52, SE = .44, p = .238, 95% CI = [−0.35, 1.39], pseudo ΔR^2 = .01). The bootstrapping results demonstrated non-significant indirect effects of the depletion manipulations on openness to dissent via perceived trust (Study 3: 95% CI = [−0.06, 0.20]; Study 4: 95% CI = [−0.08, 0.65]). To maintain the consistency of the statistical analyses between different studies, we excluded the perceived trust variable in the subsequent analyses.

Indirect effects via fatigue and anger

We followed the same procedures as in Studies 1 and 2 to assess the effects of depletion manipulations on openness to dissent via fatigue and anger. First, the depletion manipulations increased both fatigue (Study 3: B = 0.80, SE = .24, p = .001, 95% CI = [0.32, 1.27], R^2 = .05; Study 4: B = 1.04, SE = .26, p < .001, 95% CI = [0.53, 1.55], R^2 = .10) and anger (Study 3: B = 0.72, SE = .21, p < .001, 95% CI = [0.30, 1.14], R^2 = .06; Study 4: B = 1.28, SE = .26, p < .001, 95% CI = [0.76, 1.79], R^2 = .14). Specifically, participants in the depletion condition had higher fatigue and anger than did those in the non-depletion condition. The replication of the results in Study 3 suggested that the depletion manipulations with and without performance feedback had consistent effects on fatigue and anger. Aligned with our findings, Wallace and Baumeister (2002) found that providing performance feedback related to a depletion task did not significantly influence subsequent performance in a depletion task.

Next, controlling for the effect of the depletion manipulations, fatigue was not significantly associated with openness to dissent (Study 3: B = 0.01, SE = .08, p = .904, 95% CI = [−0.16, 0.18], ΔR^2 < .001; Study 4: B = −0.28, SE = .34, p = .409, 95% CI = [−0.94, 0.38], pseudo ΔR^2 = .004), but anger was significantly negatively associated with openness to dissent (Study 3: B = −0.20, SE = .10, p = .041, 95% CI = [−0.39, −0.01], ΔR^2 = .02; Study 4: B = −0.69, SE = .34, p = .039, 95% CI = [−1.35, −0.03], pseudo ΔR^2 = .03). The VIFs of the predictors were all less than 1.58 in these linear models, indicating low multicollinearity. The bootstrapping results indicated that the depletion manipulations decreased openness to dissent via increased anger (Study 3: 95% CI = [−0.36, −0.02]; Study 4: 95% CI = [−2.12, −0.13]) rather than increased fatigue (Study 3: 95% CI = [−0.12, 0.19]; Study 4: 95% CI = [−1.06, 0.42]). Thus, the results of Studies 3 and 4 replicated the findings of Studies 1 and 2 using structured conflict resolution and idea generation tasks to confirm that a depletion manipulation indirectly decreased openness to dissent through increased anger rather than fatigue.

STUDY 5: REPLICATION AND EXTENSION IN A PRE-REGISTERED STUDY

In Study 5, we aimed to replicate and extend the results of Studies 1–4 using a pre-registered study.[2] To address the limitation of the dependent measures in Studies 2 and 4,

[2] *The registration form can be accessed at: https://osf.io/zua6f/?view_only=f5302b7cf9374bd9be83299b6f4eb16c. The study data can be accessed at: https://osf.io/8gcnk/?view_only=0f2ea4cea22b42b18e41bd940569d2f1. The data of Studies 1–4 can be accessed at: https://osf.io/nbr7h/?view_only=c30c3a9475e343db97cf166fc0db2851.*

we included a choice to read an explanation of an opposing position or read evidence against an opposing position, which can keep the time-demand consistent between the two choices and eliminate an alternative explanation that a depletion manipulation decreases openness to dissent due to an avoidance of performing unnecessary work.

Participants and design

Three hundred adults were recruited via the MTurk website in exchange for monetary compensation. Two registered participants did not complete the study, and 13 participants randomly typed unrelated information for the questions regarding their initials, the reason for their initial preference in the hiring task, or the whole typing task regarding the depletion manipulation, and therefore these data points were excluded from our formal analyses. The final sample consisted of 285 participants (95.00% valid responses, 46.32% female; age: $M = 35.63$, $SD = 9.95$). Study 5 utilized the same research design (depletion: $N = 120$; non-depletion: $N = 165$) as in Studies 1–4. Study 5 also consisted of 64 dropouts in the depletion condition (dropout rate = 34.78%, [64/184]) and 8 dropouts in the non-depletion condition (dropout rate = 4.62%, [8/173]). Furthermore, the ratio of the number of dropouts to the number of valid completers (53.33%, [64/120]) in the depletion condition was higher than that in the non-depletion condition (4.85%, [8/165]; $\chi^2 = 50.37$, $df = 1$, $p < .001$).

Procedures and measures

The same procedures were used as in Studies 1–4 and participants engaged in a task with their counterpart via the Internet. Participants indicated their initials and read the same hiring task from Study 2 with a modification on the hiring candidate from Mr. Wilson to Mr. Perry. To inform participants of the purpose of the task, they read a task comprehension question and were given opportunities to select the correct purpose of the hiring task from two options (i.e., hiring as many managers as possible regardless of whether or not these managers perform well or determining whether Mr. Perry's contract should be extended) until they chose the correct option (i.e., determining whether Mr. Perry's contract should be extended).

Then, participants indicated their initial preference for the hiring decision and their reason for the preference. Subsequently, participants engaged in one of two versions of a typing task adapted from Study 3. After completing the task, participants answered the same manipulation check item ($M = 6.09$, $SD = 1.23$) and completed the same fatigue ($\alpha = .92$, $M = 2.78$, $SD = 1.70$) and anger ($\alpha = .90$, $M = 2.99$, $SD = 1.88$) scales as in Studies 1–4.

We followed the same procedure as in Study 2 to assign participants their partner, KTW. Then, participants received a message from KTW with the participant's initials which highlighted the opinion difference between participants and KTW: 'Hi [Participant's Initials], I disagree with your selection. I feel that Mr. Perry's contract should (not) be extended'. Subsequently, participants engaged in a point allocation task to indicate their preference for a choice to read KTW's explanation or evidence against KTW's selection. Specifically, they were requested to allocate 99 points to these two options. A higher number of points associated with an option reflected a stronger preference for the option. The higher number of points allocated to the choice to read KTW's explanation indicated a higher level of openness to dissent ($M = 59.62$, $SD = 28.07$). Finally, they reported their demographics and read a debriefing paragraph.

Results and discussion

Distinction between fatigue and anger

Comparative CFAs confirmed the distinctiveness of the fatigue and anger constructs. Fit statistics met acceptable criteria for the two-factor model ($\chi^2 = 37.78$, $df = 8$, $p < .001$, CFI = 0.98, SRMR = 0.03), but not the one-factor model ($\chi^2 = 292.26$, $df = 9$, $p < .001$, CFI = 0.79, SRMR = 0.11). A chi-squared difference test confirmed that the two-factor model was significantly better than the one-factor model ($\chi^2 = 254.48$; $df = 1$, $p < .001$). Fatigue and anger were significantly and positively correlated ($r = .65$, $p < .001$).

Manipulation check

The OLS regression results demonstrated that individuals in the depletion condition ($M = 6.38$, $SD = 0.97$) reported that they needed to concentrate on the typing task more than did those in the non-depletion condition ($M = 5.89$, $SD = 1.36$; $B = 0.48$, $SE = .15$, $p < .001$, 95% CI = [0.20, 0.77], $R^2 = .04$), which confirmed the effectiveness of our manipulation.

Depletion manipulation and openness to dissent

The results of robust OLS regression analyses demonstrated a marginal, negative effect of a depletion manipulation on openness to dissent ($B = -5.92$, $SE = .38$, $p = .081$, 95% CI = [−12.58, 0.74], $R^2 = .01$). Participants in the depletion condition ($M = 56.19$, $SD = 28.81$) had marginally lower openness than did those in the non-depletion condition ($M = 62.12$, $SD = 27.34$). Based on our previous discussion in Studies 1 and 2, the marginally significant, negative effect will not affect our subsequent tests of indirect effects.

Indirect effects via fatigue and anger

The results of OLS regression analyses demonstrated that a depletion manipulation did not significantly influence fatigue ($B = 0.22$, $SE = .20$, $p = .276$, 95% CI = [−0.18, 0.62], $R^2 = .004$) but increased anger ($B = 0.99$, $SE = .22$, $p < .001$, 95% CI = [0.56, 1.42], $R^2 = .07$). Specifically, participants in the depletion condition had significantly higher anger than did those in the non-depletion condition. Controlling for the effect of the depletion manipulation, fatigue ($B = -3.11$, $SE = .96$, $p = .001$, 95% CI = [−5.00, −1.22], $\Delta R^2 = .04$) and anger ($B = -2.09$, $SE = .91$, $p = .022$, 95% CI = [−3.87, −0.31], $\Delta R^2 = .02$) were significantly negatively associated with openness to dissent, respectively. The VIFs of the predictors were all less than 1.08 in these linear models, indicating low multicollinearity. The bootstrapping results indicated that the depletion manipulation decreased openness to dissent via increased anger (95% CI = [−4.45, −0.34]) rather than increased fatigue (95% CI = [−2.44, 0.43]). Thus, using a pre-registered study with an openness measure that kept the time-demand consistent between the two choices, the results of Study 5 replicated the findings of Studies 1–4 by demonstrating that a depletion manipulation indirectly decreased openness to dissent through increased anger rather than fatigue.

META-ANALYSES OF THE FIVE STUDIES

Average effect sizes of the five studies

To obtain an overall picture of the relationships under consideration, we conducted meta-analyses to estimate the average sample-weighted effect sizes of the associations between the focal variables across the five studies. Table 2 presents all the sample-weighted effect sizes and their corresponding heterogeneity. In the Appendix, the tables present effect sizes in each study. Although we did not find consistent, significant effects of depletion manipulations on openness to dissent across each of the five studies, we found a significant effect size of the average negative association between depletion manipulations and openness (d = −.30, 95% CI = [−0.42, −0.17]). Following Goh, Hall, and Rosenthal's (2016) recommendation of using an average effect size to estimate a sample size for a high-power study, we further conducted a power analysis to estimate a sample size for the effect of the depletion manipulations on openness in a future study with sufficient power. Based on an effect size from our meta-analytic results (i.e., d = −.30; power = 0.80; type I error rate = 0.05), we derived 352 participants in an equal distribution of the two conditions as a minimum sample size for sufficient power regarding the impact of depletion manipulations on openness to dissent.

Consistent with the significant indirect effects via anger rather than fatigue or trust we found in the five studies, the effect size of the average association between depletion manipulations and anger (|d| = |.57|, 95% CI = [0.42, 0.73]) was higher than those between depletion manipulations and fatigue (|d| = |.47|, 95% CI = [0.21, 0.73]) and between depletion manipulations and trust (|d| = |.12|, 95% CI = [−0.09, 0.33]). Furthermore, the effect size of the association between anger and openness (|d| = |−.45|, 95% CI = [−0.59, −0.32]) was higher than those between fatigue and openness (|d| = |−.25|, 95% CI = [−0.39, −0.11]) and between trust and openness (|d| = |.31|, 95% CI = [−0.00, 0.61]).

Heterogeneity in effect sizes and manipulation intensity as a moderator

Table 2 presents heterogeneity in the effect sizes using the indicators of Cochrane Q and I^2 with a level of significance for Q values (i.e., the 'p for Q' column). A larger value of I^2 reflects a higher level of heterogeneity in the effect sizes, which implies an existence of a potential moderator of a relationship between two variables. All Q values were non-significant (all ps ≥ .150) except for the Q value regarding the positive association between depletion manipulations on fatigue (I^2 = 74.62%, Q = 15.76, p = .003), and therefore, there may be a moderator of the association between depletion manipulations and fatigue. Hagger *et al.* (2016) proposed that depletion tasks used in the replication report might not have been of sufficient intensity and thus did not consistently elicit fatigue. Following this proposition, we examined manipulation intensity of the depletion task as a moderator of the association between depletion manipulations and fatigue. The intensity of our manipulations varied across the studies depending on the difference in the number of typing trials between the depletion and non-depletion conditions, and therefore, the values of the moderator were computed based on the differences in the number of typing trials between the conditions in the five studies.

To evaluate whether manipulation intensity would moderate the association between depletion manipulations and fatigue, we conducted a meta-regression analysis using Comprehensive Meta-Analysis (Version 3.0) software. The results demonstrated that manipulation intensity positively predicted the strength of the positive association

Table 2. Results of meta-analysis for associations between the focal variables

Associations	Cohen's *d*	*SE*	95% CI: lower limit	95% CI: upper limit	*Q*	*p* for *Q*	I^2 (%)
Depletion and openness	−.30	.07	−0.42	−0.17	1.91	.753	0.00
Depletion and fatigue	.47	.13	0.21	0.73	15.76	.003	74.62
Fatigue and openness	−.25	.07	−0.39	−0.11	4.75	.314	15.82
Depletion and anger	.57	.08	0.42	0.73	5.45	.244	26.56
Anger and openness	−.45	.07	−0.59	−0.32	4.19	.380	4.64
Depletion and trust	.12	.11	−0.09	0.33	0.01	.923	0.00
Trust and openness	.31	.16	−0.00	0.61	2.07	.150	51.79

between depletion manipulations and fatigue (B = 0.01, SE = .01, p = .011, 95% CI = [0.003, 0.026]). The results of unexplained heterogeneity were also non-significant (I^2 = 41.48%, Q = 5.13, p = .163), which suggests that there may not be other moderators of the associations between depletion manipulations and fatigue after manipulation intensity is used as a moderator. By contrast, the results of heterogeneity regarding the associations between depletion manipulations and anger were non-significant (I^2 = 26.56%, Q = 5.45, p = .244), which suggests a non-existence of potential mediators, including manipulation intensity. Therefore, our results support the idea that the manipulation intensity of a depletion task increases the positive impact of depletion manipulations on fatigue rather than anger.

GENERAL DISCUSSION

We examined how depletion manipulations and emotions influenced openness to dissent. Across multiple studies spanning various manipulations, contexts, and measures, we found support for negative causal relationships between depletion manipulations and openness to dissent. To clarify the nature of how depletion manipulations influence openness to dissent, we investigated two potential mediators of this process in contexts where cooperation requires being open to another person's differing views. Across the five studies, depletion manipulations induced lower openness to dissent through increased anger rather than fatigue. In Studies 3 and 4, we ruled out a potential perceptual process – perceived trust towards a task counterpart – as a significant mediator of the relationships between depletion manipulations and openness to dissent.

Our research not only offers the first experimental evidence across several studies that depletion manipulations causally lead to lower openness to dissenting opinions, but also provides clarity on the relative importance of anger and fatigue in mediating this relationship. As such, the results also implicate the process rather than strength model of self-control: Individuals who have completed a depletion task may become less open-minded to the dissenting opinions of others because they experience impulsive responses, such as anger. More generally, the current work suggests a major pathway through which cooperation may fail to occur. Below, we discuss in greater detail the various contributions and implications of this work.

Consequences for depletion manipulations

Our work significantly contributes to an understanding of how depletion manipulations impact behaviour and offers reasons for the inconsistent effects of depletion manipulations in previous research. Researchers have proposed that negative affective states generally mediate the process underlying the effects of depletion manipulations (Hagger *et al.*, 2010). Our research results are consistent with this conjecture and, more generally, affect valence theory (i.e., unpleasant/negative affect vs. pleasant/positive affect, Yik, Russell, & Barrett, 1999), whereby negative affect is most commonly evoked by negatively valenced/aversive events (Frijda, 1986). Our results are also consistent with a recent registered replication report of depletion manipulations indicating that depletion tasks significantly increased frustration (Hagger *et al.*, 2016).

Frustration caused by a depletion manipulation may lead to anger. Consistent with this proposition, the frustration–aggression theory predicts that frustration will lead to anger (Berkowitz, 1993), and studies have demonstrated that frustration increases anger

(Donnerstein, 1980). Participants in our studies may have regarded the typing task (i.e., the task used to manipulate ego depletion) as an unnecessary demand, and therefore, completing unnecessary work might have increased their anger. Furthermore, although we requested our participants not to reveal any information about our studies, participants in the depletion condition might still have received information from those in the non-depletion condition about a short typing task in our studies. Thus, some depletion condition participants could have expected a short and effortless study but experienced frustration by being asked to perform a long typing task. Such participants might have perceived their compensation as unfair and therefore experienced anger. Consistent with this idea, research has shown that unfair reward distribution leads to anger (Weiss, Suckow, & Cropanzano, 1999). Thus, the positive effects of depletion manipulations on anger offer insights on how individuals evaluate and emotionally respond to a depletion task. These findings also support anger as a reason why depletion manipulations lead to behavioural outcomes.

Our work also addresses the call in the replication report for future research to investigate why depletion tasks could not consistently induce fatigue (Hagger *et al.*, 2016). Hagger and colleagues proposed that ego depletion tasks used in the replication report might not have been of sufficient intensity and thus did not consistently elicit fatigue. Thus, we used different depletion tasks from those in the replication report, with task intensity varying across studies. Although depletion manipulations did not consistently decrease fatigue across the studies, our meta-analysis indicated a significant moderator – manipulation intensity – of the association between depletion manipulations and fatigue. Specifically, a depletion task with higher manipulation intensity elicited a higher level of fatigue. As such, our findings supported the proposition regarding the intensity of depletion tasks from Hagger *et al.* (2016). These findings also suggest that researchers should consider using a sufficiently high intensity of depletion manipulations to deplete self-control resources.

Our work also identifies imbalanced dropout as an explanation of why depletion manipulations did not have consistent effects on fatigue. Consistent with previous research (Zhou & Fishbach, 2016), we found that depletion manipulations led to a high attrition rate in an online environment, which implied that some participants might feel reluctant to continue with a demanding task. Many of the participants who dropped out might have reported high levels of fatigue if they had completed the depletion task. In addition, participants who completed the demanding task in the depletion condition might feel that they could perform the task without exerting much effort and thus reported a level of fatigue that was not significantly different from those in the non-depletion condition. Taken together, our research supports the manipulation intensity of depletion tasks and imbalanced dropout rates as possible reasons for inconsistent effects of depletion manipulations on fatigue.

Although unfair compensation distribution regarding the depletion manipulations and imbalanced dropout rates in the online studies may affect the results in studies with depletion manipulations, these issues may be resolved by improving the study procedures. For instance, an insertion of a filtering task in the non-depletion condition (i.e., after the non-depletion task and the measure of the focal dependent variable) can induce participants in both non-depletion and depletion conditions to form similar impressions about the length of study. Therefore, the circulated information about the study will not lead potential participants to feel unfair about study compensation. Researchers have also developed an effective intervention to decrease dropout rates in online studies (Zhou & Fishbach, 2016). Their intervention includes requesting personal

information (e.g., an email address) from participants and informing participants of relevant procedures before the study and the disadvantage of discontinuing the study (e.g., a damage to data quality). We hope that these research practices will mitigate unfair compensation distribution and imbalanced dropout rates caused by depletion manipulations.

Consequences for emotions and social influence

Our work illuminates the emotional processes mediating the relationship between depletion manipulations and receptivity to social influence. Based on research on discrete emotions (Barsade & Gibson, 2007), anger is a negative emotion associated with a high level of energy that enables individuals to remove their social obstacles and orient towards their goals (Carver & Harmon-Jones, 2009). During the process of achieving a desired goal, anger may increase a focus on the fault of others' actions (Ortony, Clore, & Collins, 1988) and promote efforts to dominate another person's behaviour (Fischer & Roseman, 2007). These behaviours may enable the obtainment of one's own position and constitute barriers to openness. By contrast, fatigue is a negative emotion associated with a lack of energy (Barsade & Gibson, 2007), which may have a minimal impact on effortful endeavours such as resisting openness. Our empirical findings and the theoretical framework of discrete emotions complement and extend work on depletion manipulations by identifying anger rather than fatigue as an important mediator of the relationship between depletion manipulations and openness to dissent.

Our work also offers a novel implication of how depletion manipulations affect receptivity to social influence through emotions. Past research has demonstrated a positive impact of a depletion manipulation on such receptivity. For instance, a depletion manipulation leads to compliance with a request from others (Fennis, Janssen, & Vohs, 2009). Researchers have also proposed fatigue as a mediator of the positive association between depletion manipulations and receptivity to social influence (Burkley *et al.*, 2011), and found non-significant effects of anger on perspective-taking (Todd, Forstmann, Burgmer, Brooks, & Galinsky, 2015). The differences between previous findings and our findings may be due to differences in measures of receptivity to social influence: Previous research focused on the creation of a new preference that did not go against an existing preference whereas, in our research, receptivity to new preferences involved changing or forgoing one's own preferences, such as agreeing to a dissenting opinion. Thus, changing an original preference may reverse the positive relationship between depletion manipulations and receptivity to social influence. That is, given that anger motivates individuals to overcome a potentially undesirable situation (Frijda, 1986), individuals who completed a depletion task may experience anger when confronted with a dissenting opinion that blocks the fruition of their own opinions. Such anger may induce the individuals to reject the dissenting opinion, thereby overcoming the obstacle and avoiding any discomfort or threat to personal beliefs associated with preference change. Thus, our research supports that depletion manipulations can decrease receptivity to change regarding one's original preferences via increased anger.

Future research

Questions raised by the research presented here provide opportunities for future studies. For instance, researchers can investigate whether contexts can moderate the effects of depletion manipulations on anger. Although our findings demonstrated the positive

effects of depletion manipulations on anger, other research has failed to detect such significant effects (Fischer, Kastenmüller, & Asal, 2012). A potential reason for the discrepancy is that the other research did not involve opportunities for participants to interact with others. By contrast, our task settings may have led depleted participants to generate more anger, which could signal toughness and therefore elicit concession responses from other parties (Sinaceur & Tiedens, 2006). Thus, it is important to investigate whether our findings can be replicated in situations that do not require the integration of different viewpoints (e.g., teams with homogeneous opinions, Hoever, van Knippenberg, van Ginkel, & Barkema, 2012) and in other social domains (e.g., romantic relationships, Fletcher, Kerr, Li, & Valentine, 2014).

Although we did not find a consistent, significant association between fatigue and openness to dissent, future research could examine contexts that may influence when fatigue has positive or negative effects on openness. As discussed previously, individuals who experience fatigue may be resistant to dissenting opinions due to a perception of limited resources (Lapointe *et al.*, 2011), or more open to dissent due to a motivation to seek acceptance in personal relationships (Halbesleben, 2006). For example, the distinction between ingroup and outgroup members (e.g., people who support the same sports team and the rival team, respectively; Apps, McKay, Azevedo, Whitehouse, & Tsakiris, 2018) may moderate the association between fatigue and openness to dissent. Individuals who experience fatigue may be more open to an ingroup member's different perspectives because they are more likely to seek acceptance from him or her. However, individuals may be more resistant to an outgroup member's different perspectives because they have fewer resources with which to successfully defend themselves from the member who may provide less support and be more likely to take advantage of them. Thus, interpersonal closeness may increase the positive impact of fatigue on openness.

In addition, different types of fatigue may have different impacts on openness to dissent. Specifically, mental fatigue caused by a depletion task may have a stronger negative impact than sleepiness-induced fatigue. Researchers have proposed ego depletion as short-term mental fatigue, which leads individuals to focus on their personal goals (Inzlicht, Schmeichel, & Macrae, 2014). This proposal suggests that depletion-task-relevant fatigue decreases openness to dissent. By contrast, sleep deprivation tends to increase susceptibility to suggestions (Blagrove, 1996), and adolescents with insufficient sleep are more likely to use marijuana due to peer influence (Mednick, Christakis, & Fowler, 2010). These findings suggest that sleepiness-induced fatigue increases openness to dissent. Consistent with our proposition regarding the differential effects of mental fatigue and sleepiness-induced fatigue, research has indicated that mental fatigue was more likely to increase aggression than sleepiness-induced fatigue (Vohs, Glass, Maddox, & Markman, 2011). The differentiation between task-induced fatigue and sleepiness-induced fatigue suggests that the relationship between fatigue and openness to dissent depends on what is causing fatigue.

Concluding remarks

As Nobel laureate Niels Bohr once conveyed in a letter to the United Nations, openness is a necessary step to sustain cooperation (Bohr, 1950). Our research has suggested that performing a frustrating and demanding task that elicits anger presents a significant obstacle to being open and thus to achieving cooperation. Indeed, our results indicate that depletion manipulations lead to lower openness via increased anger rather than fatigue. To our knowledge, this is the first investigation of the causal effect of depletion

manipulations on openness via different emotional mediators. Such findings have broad potential impacts on various areas of psychology, including group and interpersonal processes, social influence, emotion, motivation, social cognition, and decision-making.

In addition, given that recent replication studies have failed to detect significant effects of depletion manipulations, our findings offer a potential explanation for the non-significance: The effects found in studies with depletion manipulations may be due to the amount of anger elicited by frustrating depletion tasks. Moreover, short depletion manipulations did not consistently increase fatigue in the registered replication report. Our meta-analytic results offer a reason for these inconsistent effects by demonstrating that the strength of depletion manipulation effects on fatigue depends on the manipulation intensity of the depletion task. Thus, we hope that the current findings can not only offer possible insights into the recent unsuccessful replication studies regarding the effects of depletion manipulations but also help clarify a potential pathway for why individuals often fail to consider others' perspectives and, thus, fail to cooperate.

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Appendix: Relationships between variables

Study	Cohen's *d*	*SE*	Variance	95% CI: lower limit	95% CI: upper limit	*Z*	*p*
The association between ego depletion and openness							
1	−.33	0.17	0.03	−0.66	0.01	−1.91	.057
2	−.25	0.14	0.02	−0.53	0.04	−1.70	.089
3	−.31	0.14	0.02	−0.60	−0.03	−2.17	.030
4	−.48	0.17	0.03	−0.81	−0.15	−2.88	.004
5	−.21	0.12	0.01	−0.44	0.02	−1.75	.080
Random	−.30	0.07	0.00	−0.42	−0.17	−4.55	<.001
The association between ego depletion and fatigue							
1	.91	0.19	0.03	0.55	1.28	4.90	<.001
2	.28	0.14	0.02	0.00	0.57	1.96	.050
3	.47	0.15	0.02	0.19	0.76	3.23	.001
4	.65	0.17	0.03	0.32	0.98	3.81	<.001
5	.13	0.12	0.01	−0.10	0.36	1.09	.277
Random	.47	0.13	0.02	0.21	0.73	3.50	<.001
The association between fatigue and openness							
1	−.09	0.17	0.03	−0.42	0.25	−0.50	.615
2	−.11	0.14	0.02	−0.39	0.17	−0.79	.431
3	−.17	0.14	0.02	−0.45	0.11	−1.17	.242
4	−.43	0.17	0.03	−0.75	−0.10	−2.56	.010
5	−.40	0.12	0.01	−0.63	−0.16	−3.27	.001
Random	−.25	0.07	0.01	−0.39	−0.11	−3.47	<.001
The association between ego depletion and anger							
1	.81	0.18	0.03	0.45	1.16	4.41	<.001
2	.38	0.15	0.02	0.09	0.66	2.58	.010
3	.49	0.15	0.02	0.20	0.77	3.31	.001
4	.79	0.17	0.03	0.45	1.13	4.54	<.001
5	.54	0.12	0.02	0.30	0.78	4.36	<.001
Random	.57	0.08	0.01	0.42	0.73	7.25	<.001
The association between anger and openness							
1	−.41	0.17	0.03	−0.75	−0.07	−2.37	.018
2	−.65	0.15	0.02	−0.94	−0.35	−4.30	<.001
3	−.37	0.15	0.02	−0.66	−0.09	−2.58	.010
4	−.62	0.17	0.03	−0.95	−0.29	−3.65	<.001
5	−.32	0.12	0.01	−0.56	−0.08	−2.65	.008
Random	−.45	0.07	0.00	−0.59	−0.32	−6.69	<.001
The association between ego depletion and trust							
3	.11	0.14	0.02	−0.17	0.39	0.77	.440
4	.13	0.16	0.03	−0.19	0.45	0.81	.419
Random	.12	0.11	0.01	−0.09	0.33	1.11	.266
The association between trust and openness							
3	.46	0.15	0.02	0.17	0.74	3.11	.002
4	.14	0.16	0.03	−0.18	0.46	0.86	.388
Random	.31	0.16	0.02	−0.00	0.61	1.94	.052